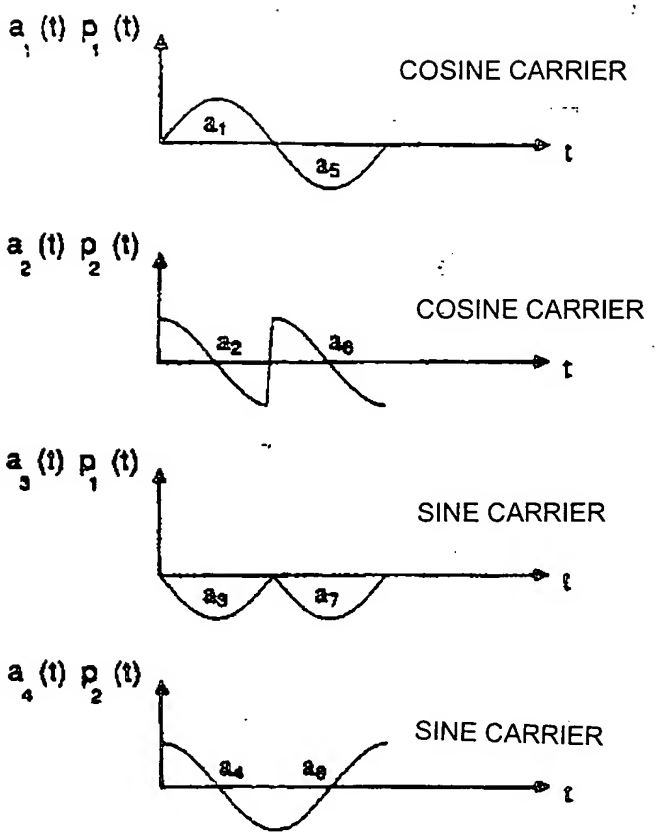

a1 (t) p1 (t)
COSINE CARRIER
a1
a5
t
a2 (t) p2 (t)
COSINE CARRIER
a2
a6
t
a3 (t) p1 (t)
SINE CARRIER
a3
a7
t
a4 (t) p2 (t)
SINE CARRIER
a4
a8
t
-T 0 T 2T 3T

Fig. 1

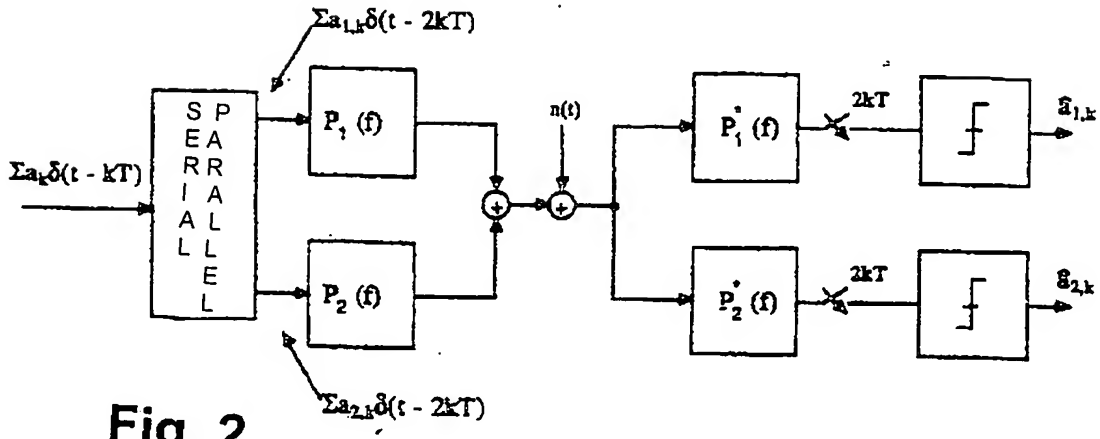

Σa1,kδ(t - 2kT)
Σa1kδ(t - kT)
SERIAL
PARALLEL
P1 (f)
P2 (f)
n(t)
P1* (f)
P2* (f)
2kT
2kT
â1,k
â2,k
Σa2,kδ(t - 2kT)

Fig. 2

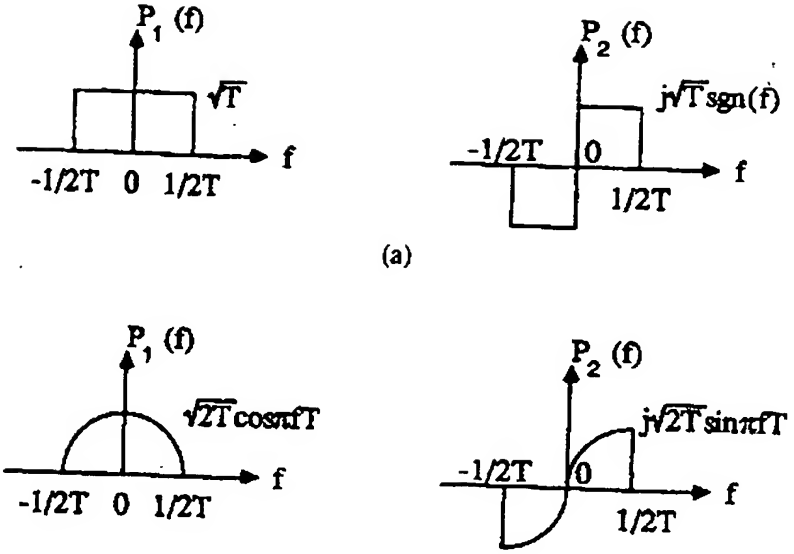

P1 (f)
√T
f
-1/2T 0 1/2T
P2 (f)
j√T sgn(f)
-1/2T 0
f
1/2T
(a)
P1 (f)
√2T cosπfT
f
-1/2T 0 1/2T
P2 (f)
j√2T sinπfT
-1/2T 0
f
1/2T
(b)
P1 (f)
√2T cosπfT
f
-1/2T 0 1/2T
P2 (f)
jKf
-1/2T
f
0 1/2T
(c)

Fig. 3

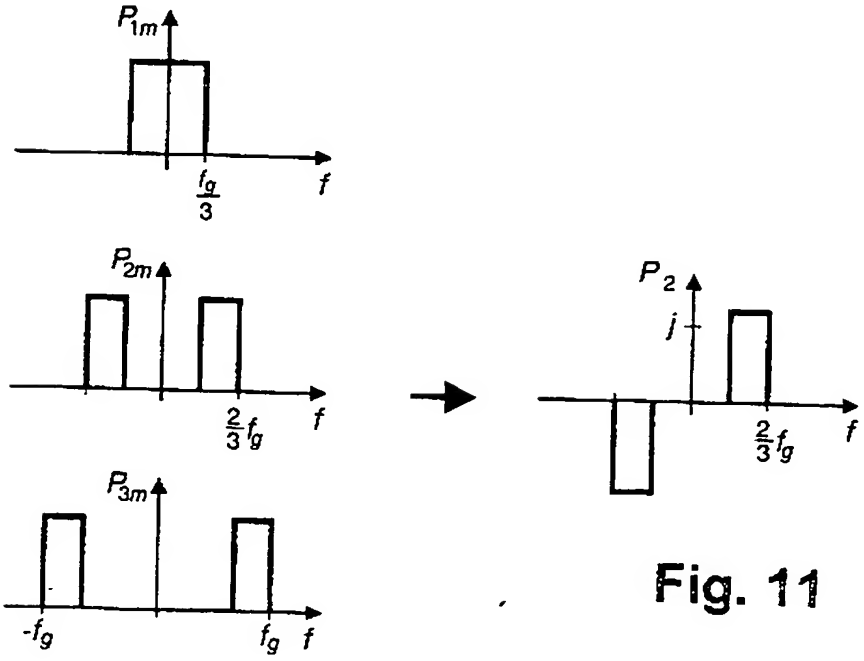

P1m
fg/3
f
P2m
2/3 fg
f
P3m
-fg
fg f
P2
j
2/3 fg
f

Fig. 11

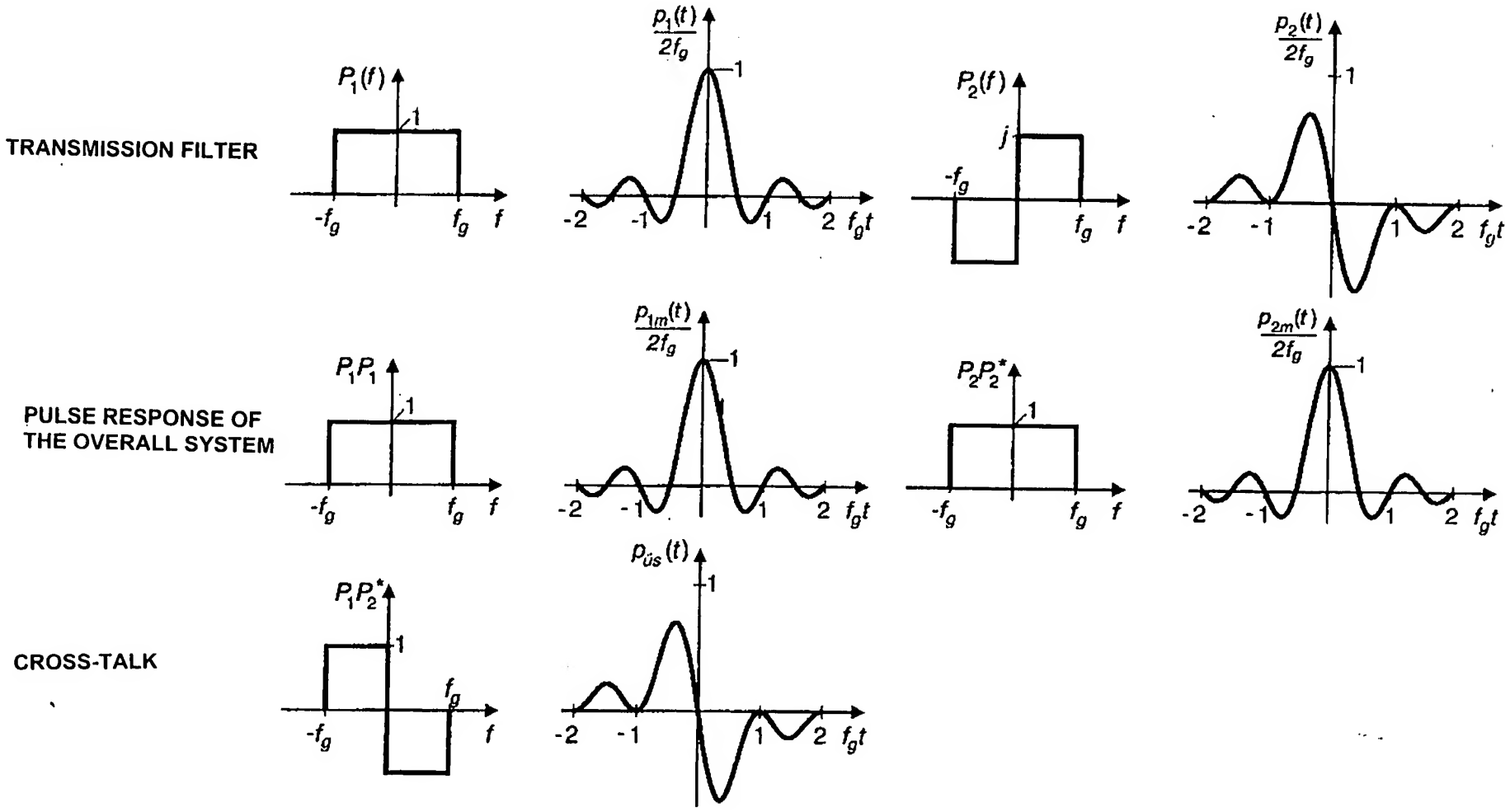


Fig. 3a

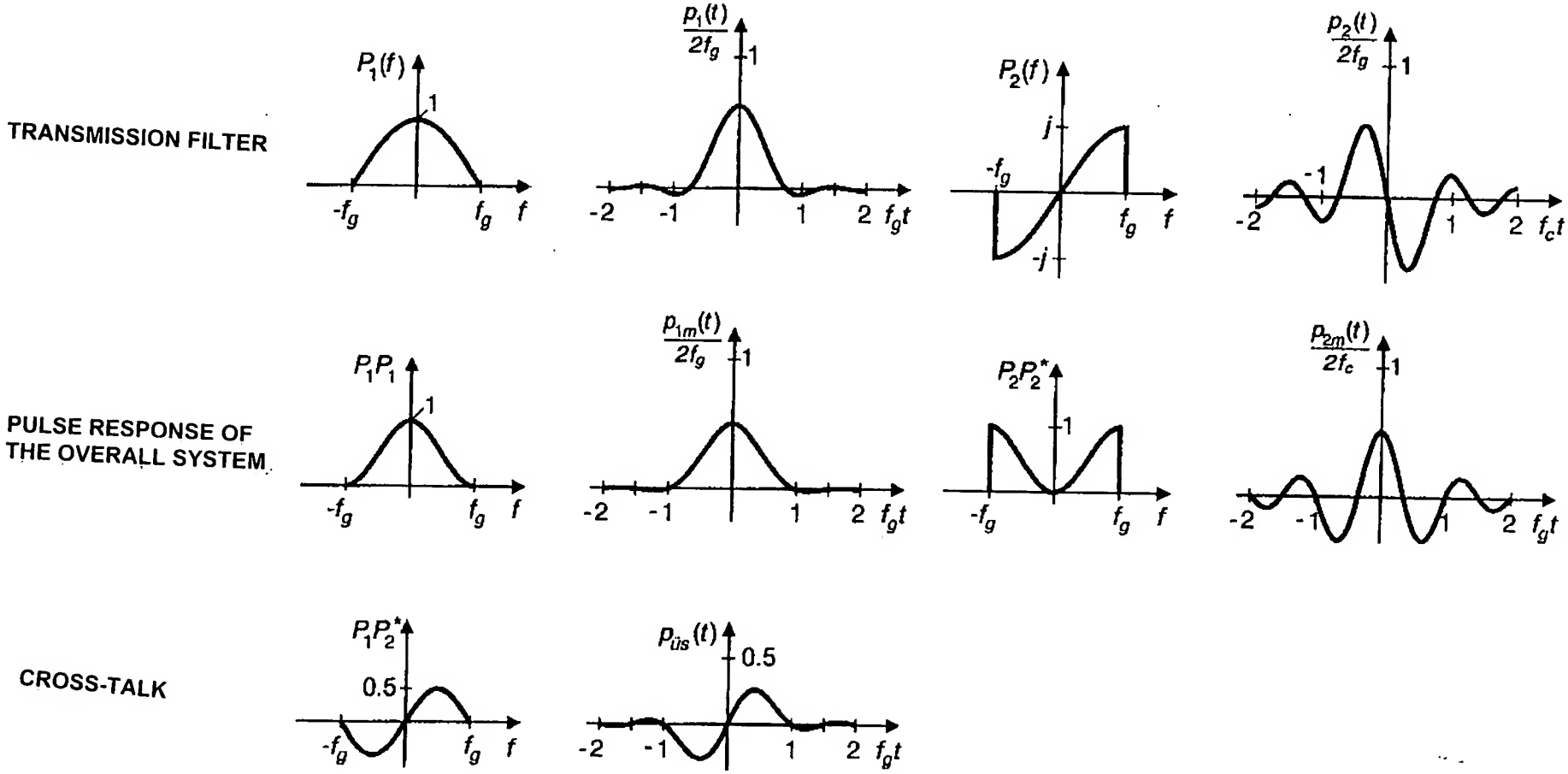


Fig. 3b

TRANSMISSION FILTER

PULSE RESPONSE OF THE OVERALL SYSTEM

CROSS-TALK

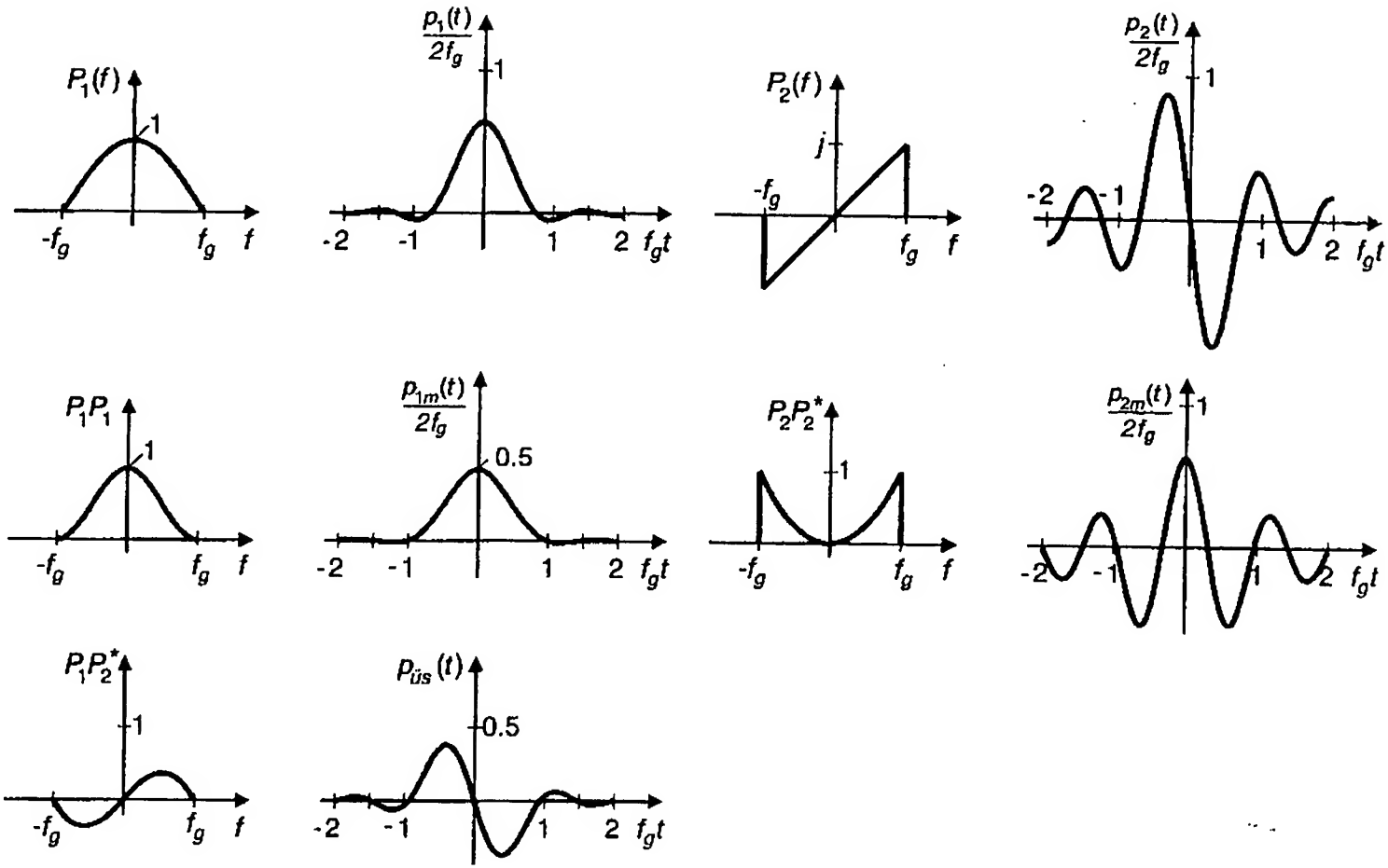
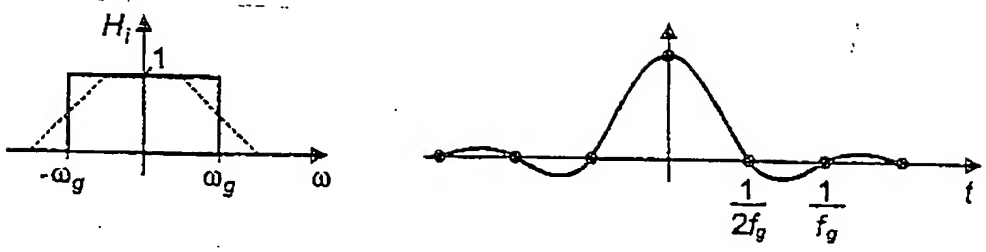
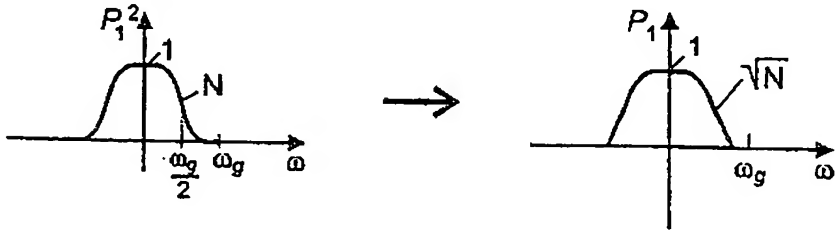


Fig. 3c

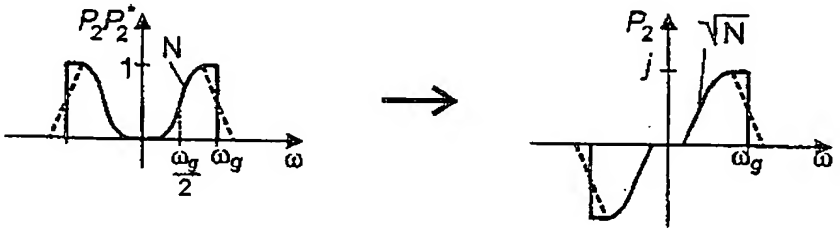
The starting point here is the ideal low-pass



Step 1: Select P_1^2 in such a manner that the zero points are at a multiple of $1/f_g$ and determine P_1



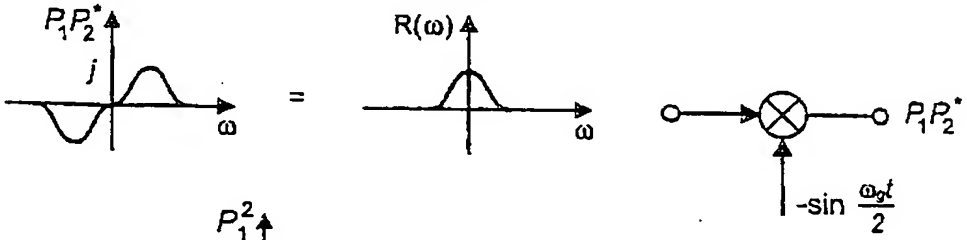
Step 2: Select $P_{2m} = P_2 P_2^*$ as $P_{2m} = H_i - P_1^2$ and from that P_2



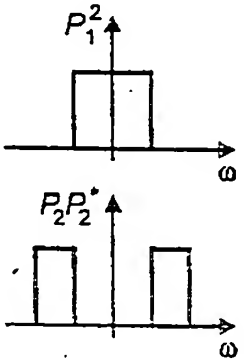
Both filters have Nyquist flanks

$P_1P_2^*$ or P_2 A P_1^* are symmetrical to $\omega_g/2$ ~> no cross-talk

Proof:

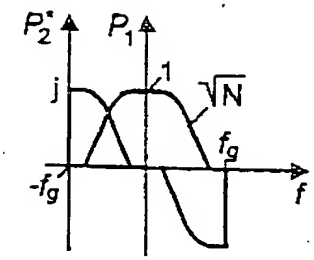


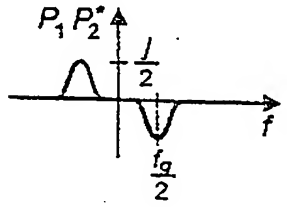
Special case:



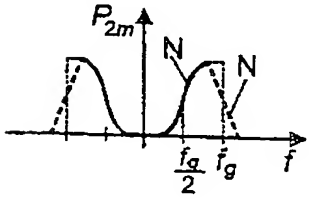
FDM

Fig. 4

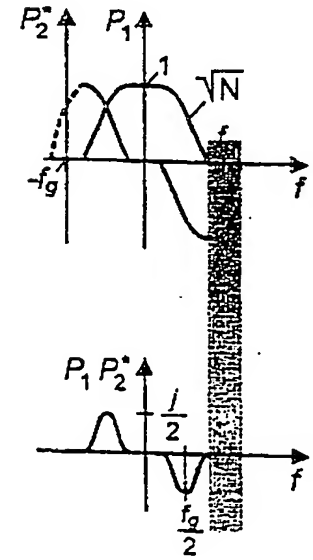




Zeros at multiples of $1/f_g$ ~> no cross-talk

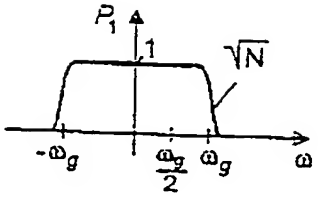


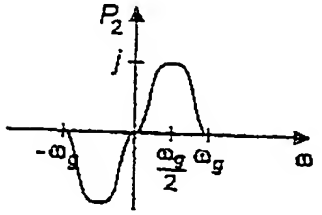
Avoidance of perpendicular flanks by means of Nyquist flank



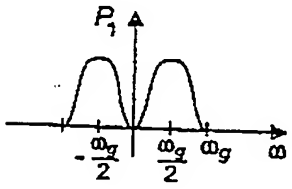
No cross-talk if P_1 does not fall into the Nyquist flank N at f_g

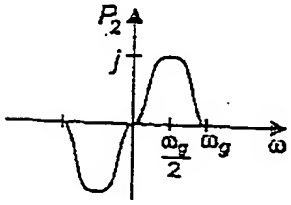
Fig. 5



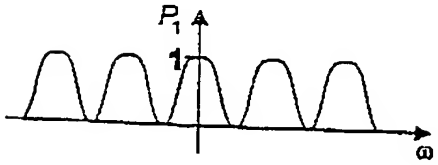


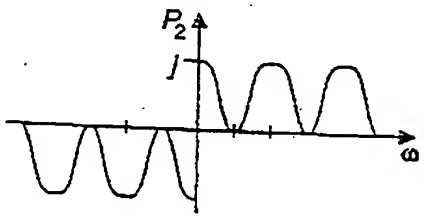
Example d





Example e

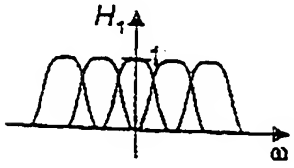


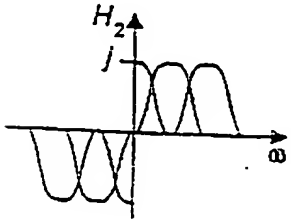


Example f

Multi-carrier system

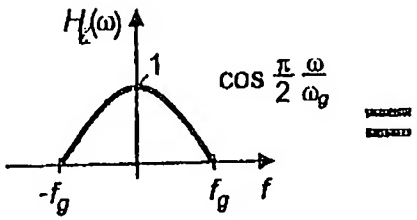
Fig. 6



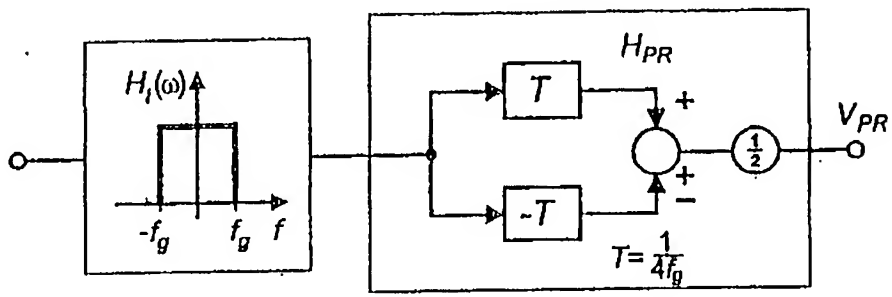


Example g

Multi-carrier system

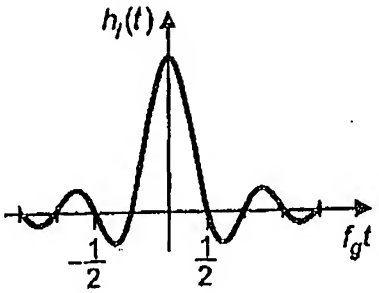


Pulse formation



$$\frac{e^{j\omega T} + e^{-j\omega T}}{2} = \cos \omega T$$

$$\frac{e^{j\omega T} - e^{-j\omega T}}{2} = j \sin \omega T$$



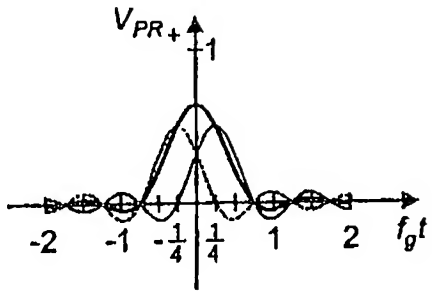
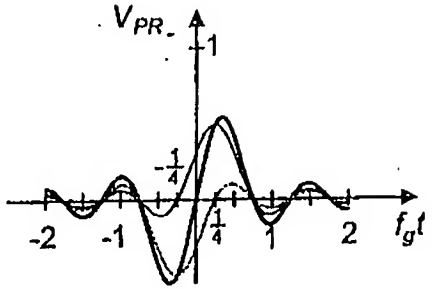


Fig. 7



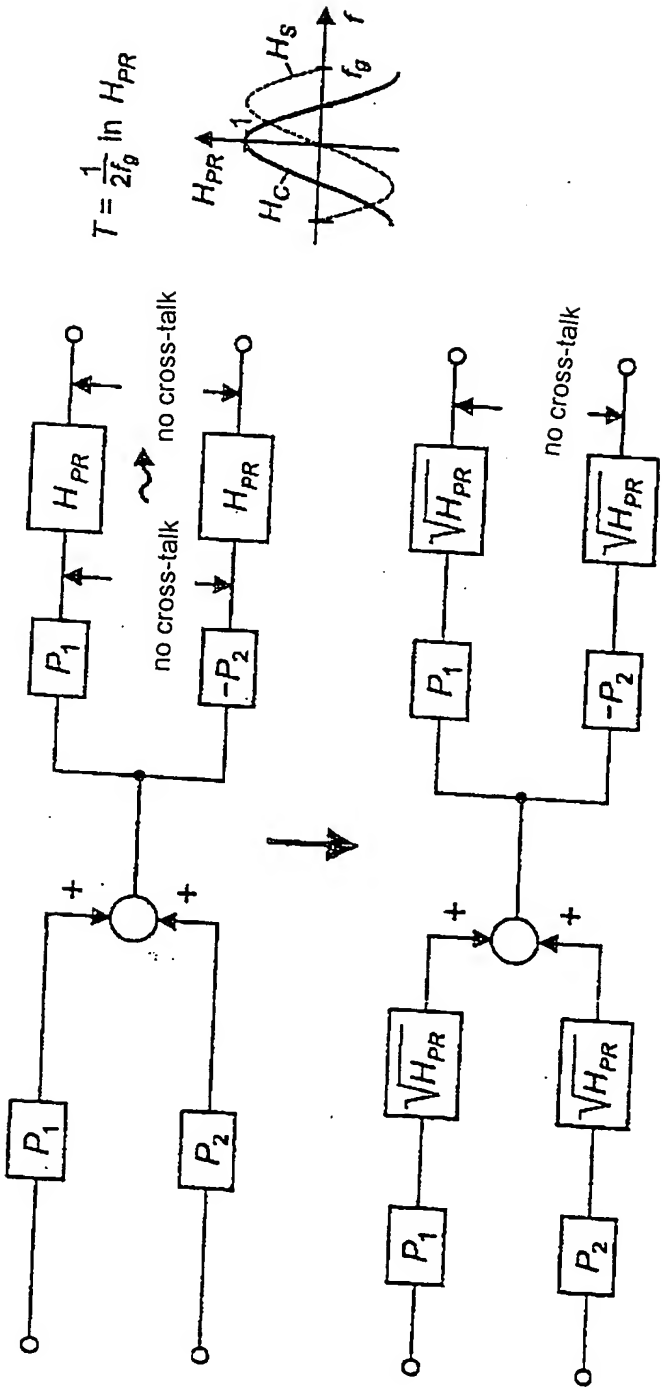

$T = \frac{1}{2f_g} \ln H_{PR}$
H_{PR}
1
H_S
f_g
f
H_C
H_{PR}
P_1
$-P_2$
no cross-talk
no cross-talk
P_1
P_2
$\sqrt{H_{PR}}$
$\sqrt{H_{PR}}$
P_1
$-P_2$
no cross-talk
$\sqrt{H_{PR}}$
$\sqrt{H_{PR}}$
P_1
P_2
+
+
+
+

Fig. 8

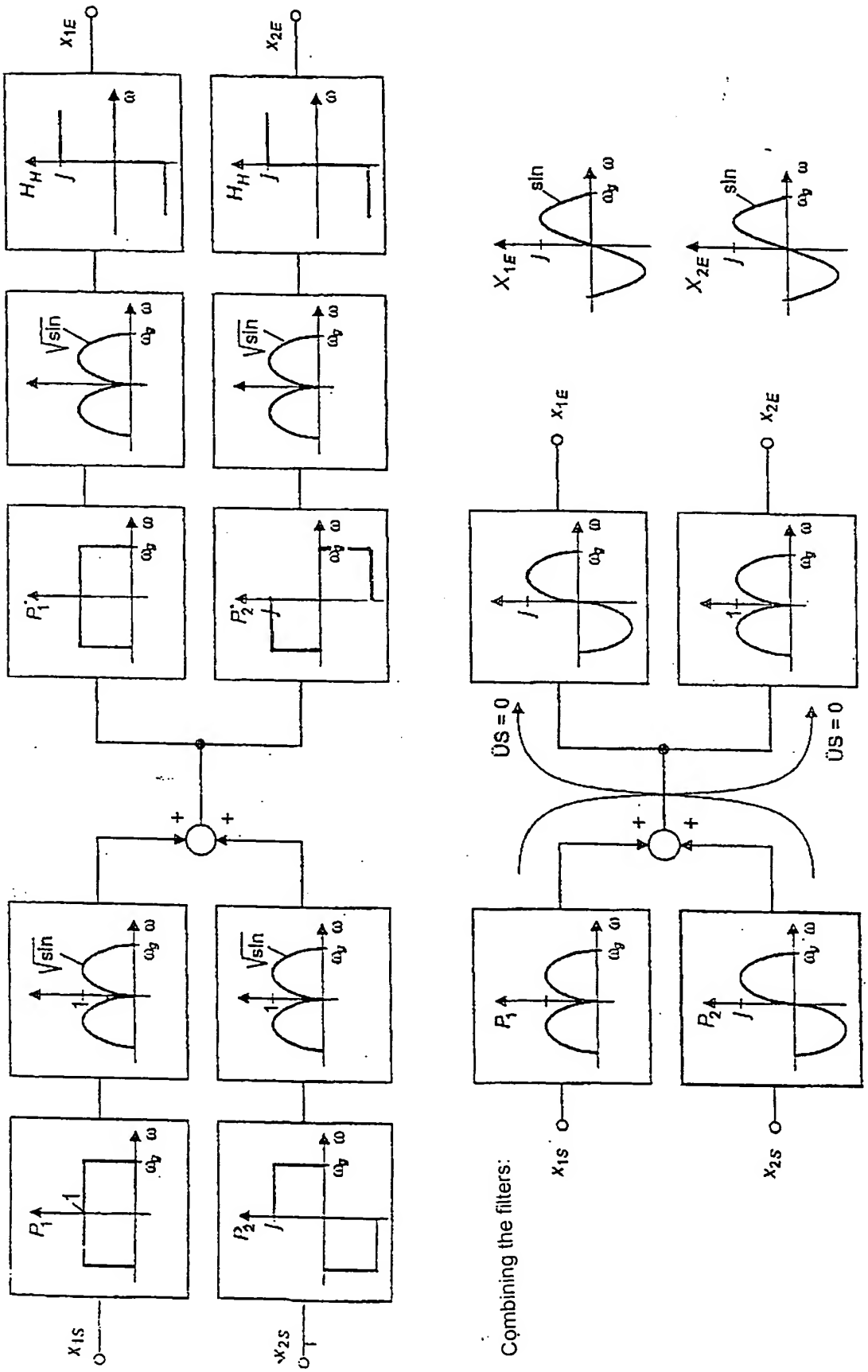
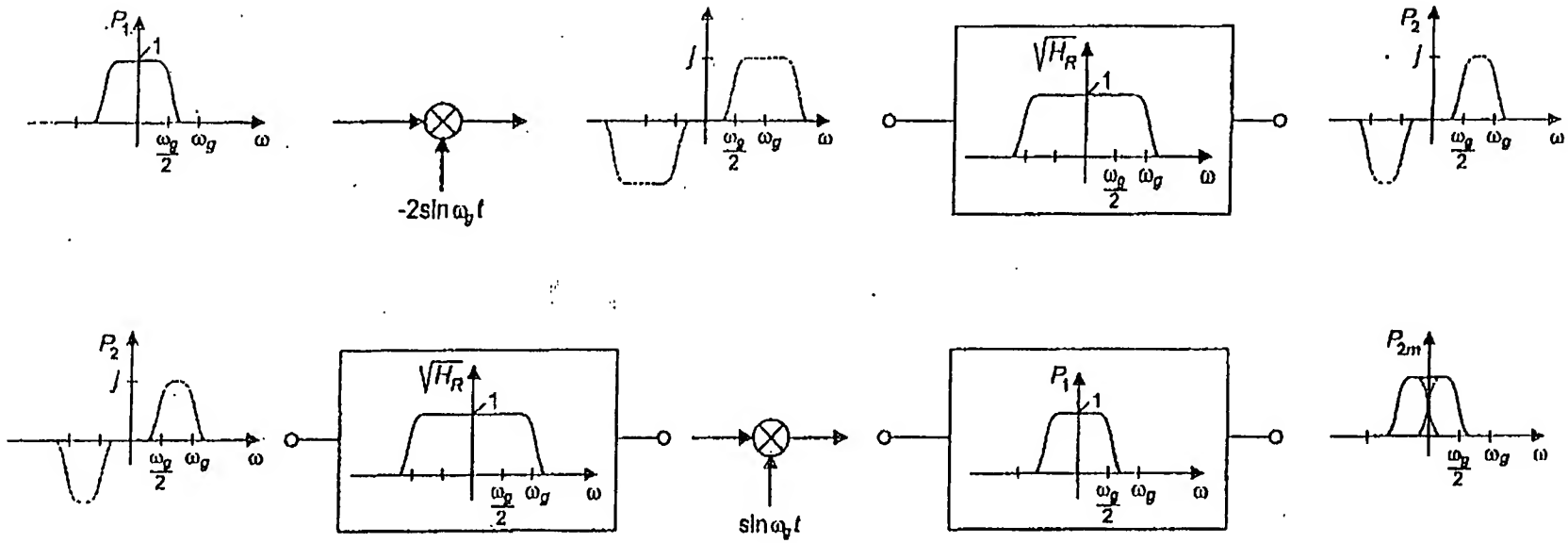


Fig. 9



Alternative Demodulation:

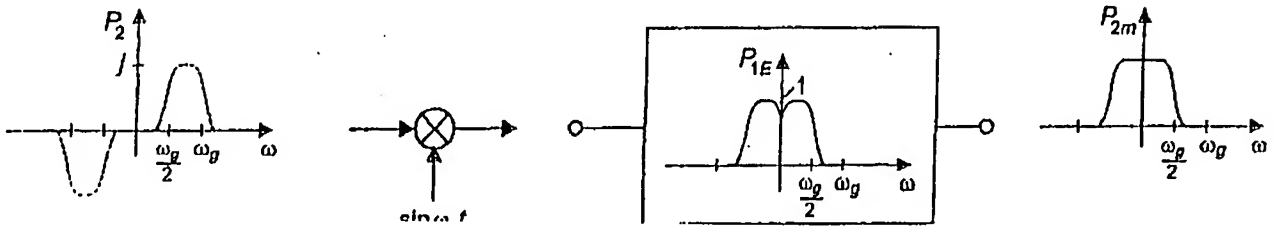


Fig. 10

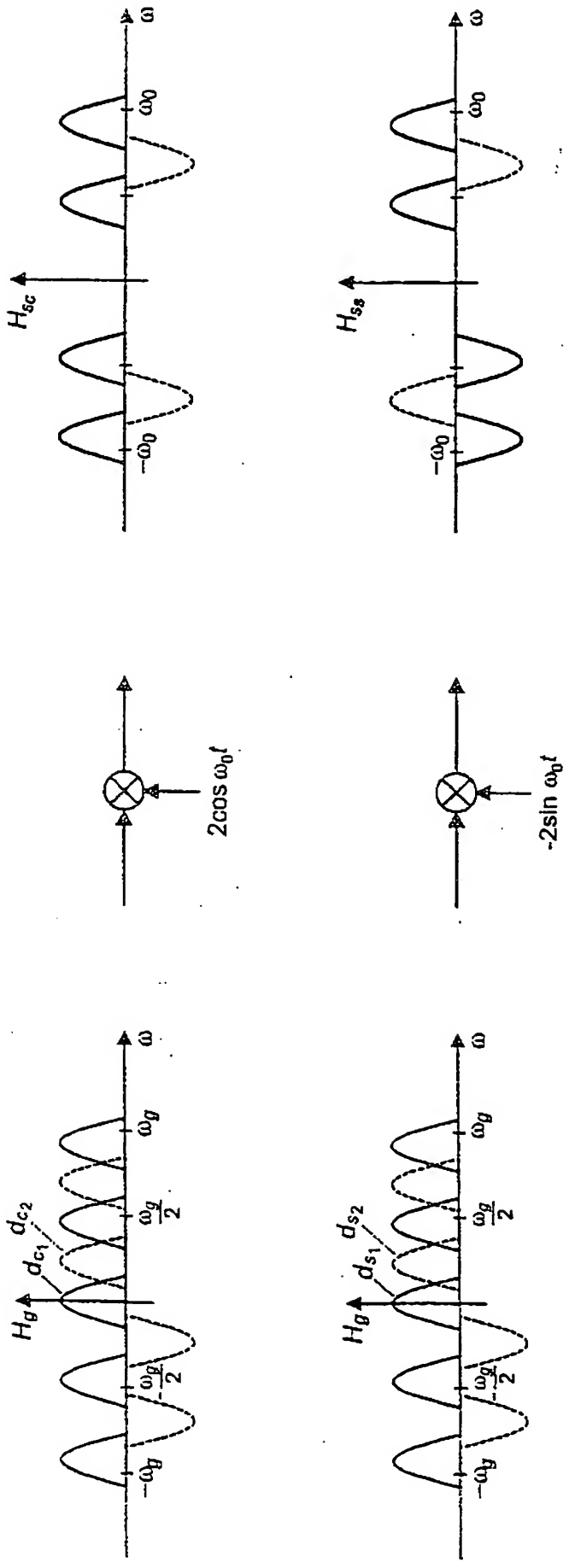

ω
ω_0
$-\omega_0$
H_{sc}
H_{ss}
$2\cos\omega_0 t$
$-2\sin\omega_0 t$
ω_g
$\frac{\omega_g}{2}$
$-\frac{\omega_g}{2}$
$-\omega_g$
H_g
d_{c_2}
d_{c_1}
d_{s_2}
d_{s_1}

Fig. 12

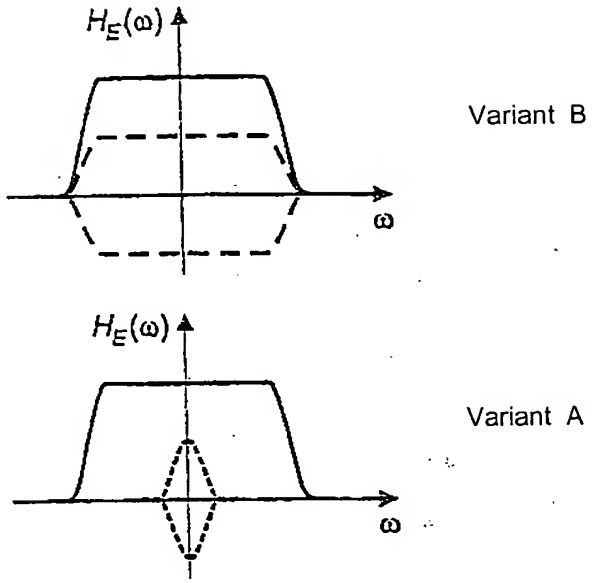

$H_E(\omega)$
ω
Variant B
$H_E(\omega)$
ω
Variant A

Fig. 13

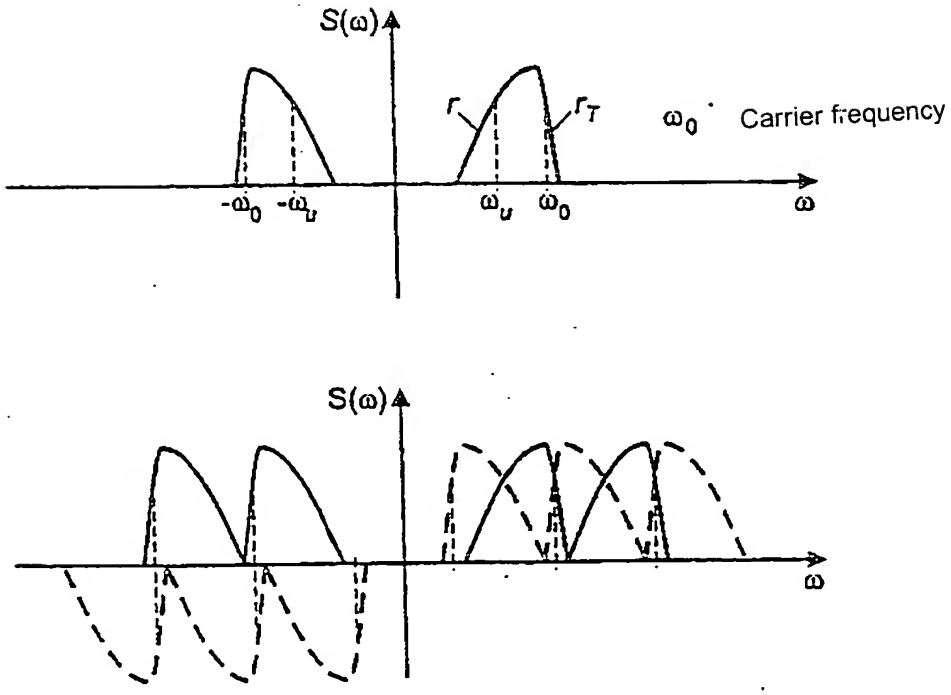

S(ω)
r
r_T
ω_0
Carrier frequency
$-\omega_0$
$-\omega_u$
ω_u
ω_0
ω
S(ω)
ω

Fig. 14

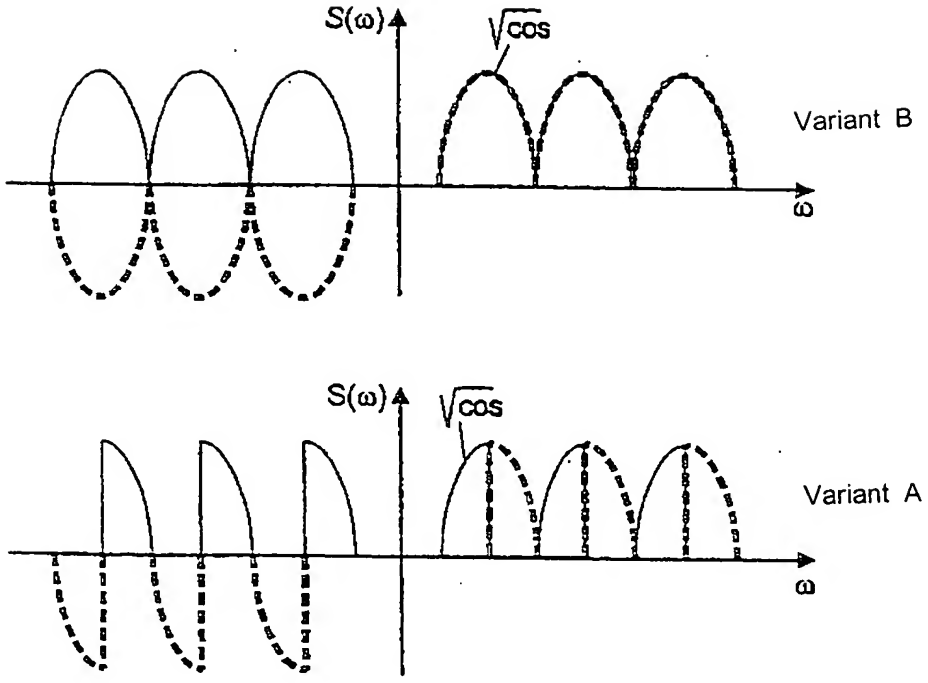


Fig. 15

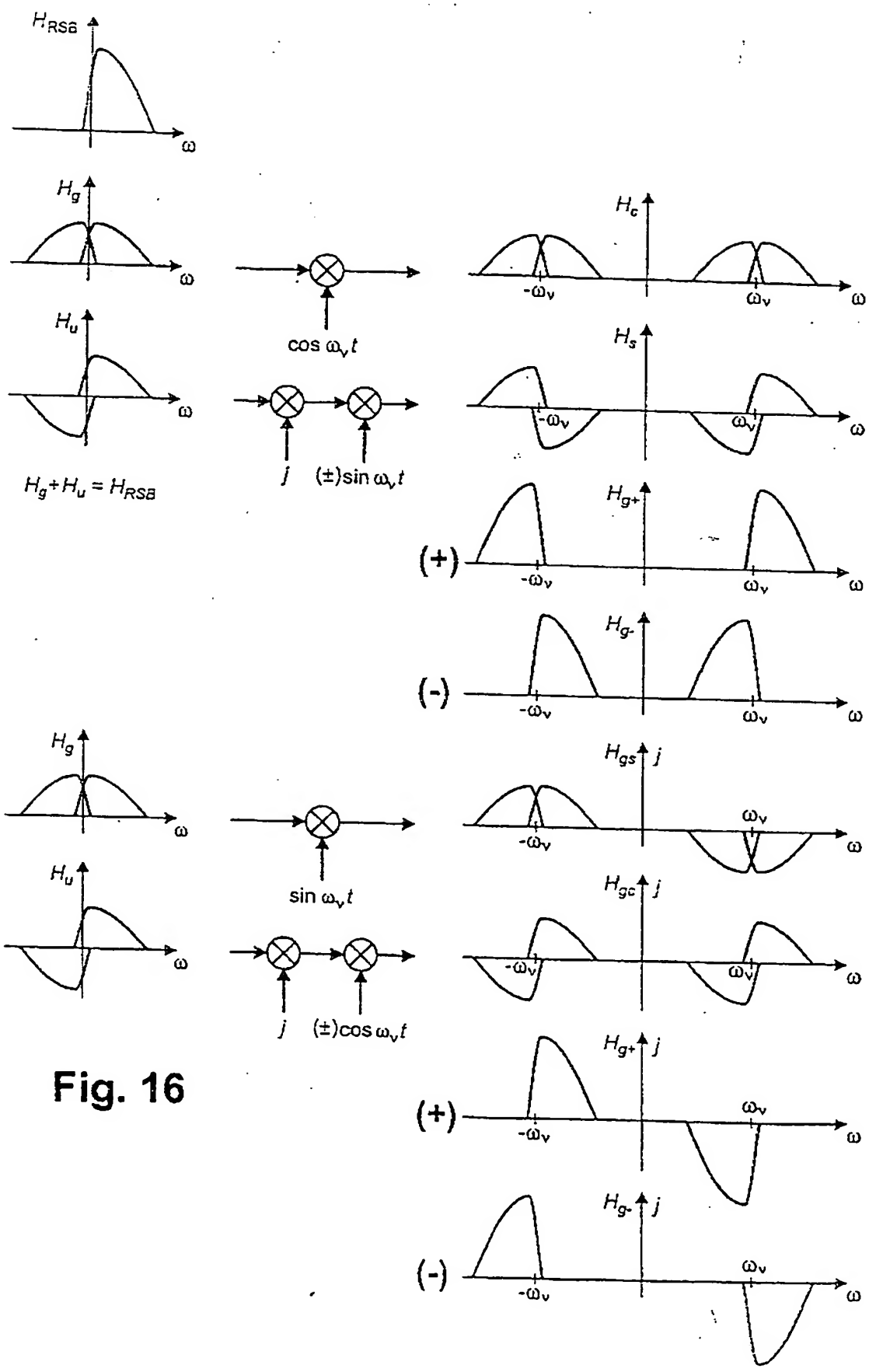

H_{RSB}
ω
H_g
H_u
$H_g+H_u = H_{RSB}$
cos $\omega_v t$
j (±)sin $\omega_v t$
H_c
H_s
H_{g+}
H_{g-}
(+)
(-)
$-\omega_v$
ω_v
sin $\omega_v t$
j (±)cos $\omega_v t$
H_{gs} j
H_{gc} j

Fig. 16

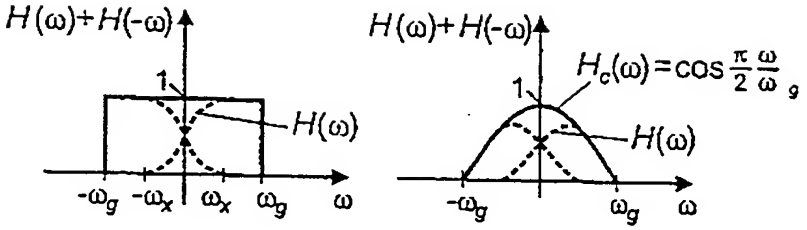


Fig. 17